Message

From: Grange, Gabrielle Fenix [Gabrielle.Grange@doh.hawaii.gov]
Sent: 10/7/2021 9:14:52 PM
To: Palazzolo, Nicole [Palazzolo.Nicole@epa.gov]; g.d.beckett@aquiver.com
Subject: RE: Red Hill LNAPL Model Example

Great! Thanks, GD.

We may want to consider a 3D version to give a bit of a better sense of the variety of fast track pathways that could occur under different release locations and spill scales. Showing stakeholders the speed and mobility of LNAPL in the system may help get the message home in a way that just talking about CF&T hasn't been able to.

Fenix

From: Palazzolo, Nicole <Palazzolo.Nicole@epa.gov>
Sent: Thursday, October 7, 2021 10:24 AM
To: g.d.beckett@aquiver.com
Cc: Grange, Gabrielle Fenix <Gabrielle.Grange@doh.hawaii.gov>
Subject: [EXTERNAL] RE: Red Hill LNAPL Model Example

Great idea Gary. I will forward to Alex and Tom.

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From: g.d.beckett@aquiver.com <g.d.beckett@aquiver.com>
Sent: Thursday, October 7, 2021 9:42 AM
To: Palazzolo, Nicole <Palazzolo.Nicole@epa.gov>
Cc: Grange, Gabrielle Fenix <gabrielle.grange@doh.hawaii.gov>
Subject: RE: Red Hill LNAPL Model Example

Hi Nicole,

Would you like me to forward this modeling animation and note to Alex & Tom? Perhaps you already did so.

I think it was Tom who spoke about challenges in hard-rock basalt modeling of contaminant behavior, so it may be relevant. Again, it is a framing analysis only, we expect the actual conditions to be much more complex. That is often handled by geometric evaluations, scaling factors, or other approaches that can better capture the root causes of complex multiphase migration behavior. Our framing (Matt, Bob & I worked on this), however, is more complex & realistic than anything the Navy has so far done. Oversimplification often leads to non-conservative results.

The one key takeaway that I think was echoed on yesterday's call is that NAPL movement will always be highly complex in these types of settings. To me, the value of modeling is that it forces one to address the key elements of the

processes at work and helps to narrow down which are important and which are not, as well as identifying specific uncertainties. A saying comes to mind: modeling may not tell you what is right, but it often tells you what is wrong.

Best regards

From: g.d.beckett@aquiver.com <g.d.beckett@aquiver.com>
Sent: Tuesday, September 28, 2021 5:34 PM
To: 'Palazzolo, Nicole' <Palazzolo.Nicole@epa.gov>; 'Carvalho, Gabriela' <Carvalho.gabriela@epa.gov>; 'Duffy, Mark' <duffy.mark@epa.gov>; 'Tu, Lyndsey' <Tu.Lyndsey@epa.gov>; 'Matt Tonkin' <matt@sspa.com>; 'Whittier, Robert' <Robert.Whittier@doh.hawaii.gov>; 'Shende, Anay' <anay.shende@doh.hawaii.gov>; 'dthomas@soest.hawaii.edu' <dthomas@soest.hawaii.edu>; 'g.d.becket aquiver.com' <g.d.becket@aquiver.com>; 'Ichinotsubo, Lene K' <lene.ichinotsubo@doh.hawaii.gov>; 'Grange, Gabrielle Fenix' <gabrielle.grange@doh.hawaii.gov>
Cc: 'Fong, Alison' <fong.alison@epa.gov>
Subject: Red Hill LNAPL Model Example

Hi folks,

It strikes me that with some new EPA folks, I may have jumped to some observations regarding the limitations of groundwater modeling alone to inform our considerations for the best applicable aquifer protection strategies. Fenix agreed it might be good to share our example draft fuel release modeling with you all before our call on Friday. The primary purpose of these multiphase modeling examples was to show our stakeholders and the Navy's technical team that such modeling can be efficiently done to address the flaws of the Navy holding model and their other proposed approaches. Those primary flaws are: a) non-dynamic; b) uniformity of modeling dimensions, unconstrained by any field data; c) residual already in-place; d) cannot simulate time-dependent migration; and e) all parameters are assumed from inapplicable literature (no acceptable site or area-specific measurements).

As background, Matt and I worked on the lithologic distributions based on the 3-D geologic model available at that time. We then took a lithologic "slice" through the axis of the Tank Farm to feed into a 2-D numerical model in cross-sectional orientation. That model, MAGNAS3 (1998), is fully capable of 3-phase simulation (vapor, NAPL and water) in 1-, 2-, and 3-D. We chose 2-D for our draft example to keep the work effort minimal. We were not recommending that model per se, although Sorab Panday is certainly proficient with it as he is one of its co-authors. But we did intend to point out the importance of heterogeneity, release characteristics, and anticipated changes with time and distance. Our example models were then parameterized with known and assumed parameters for the lithologies and fuel, along with 3 release scenarios (small, large & chronic). The releases were scaled downward in volume to account for the way 2-D models account for mass; i.e., a more realistic but less conservative assumption. The model input parameters were based on site values were available (e.g., aquifer testing for hydraulic conductivity), or literature and compiled data. Some of you know that I compiled the API LNAPL Parameters DB (API #4731) and these attributes were part of my research focus at SDSU. Because of our demonstration of the inapplicability of the Navy's petrophysical testing results, assumed properties are all that are available to any of us for most of the sensitive factors (e.g., relative permeability, capillarity, etc.).

Anyway, this type of modeling can inform us about the rate, distances, and degree of aquifer impacts that might occur under various release conditions. Further, we have presented some literature on the often fractal and heterogeneous behavior of NAPLs in hard-rock settings. That kind of architectural framing would also be relevant to the upscaling of various parameters, such as residual capacity. We have asked for that from the Navy many times, but nothing returned thus far. Absent realistic and conservative modeling, we would be left to assume potential conditions, which can also be done (but has not by Navy).

Ultimately, it will be the nexus between fuel transport and the potential methods of its mitigation that will determine the best aquifer protection measures. If for instance, a large-scale release is estimated to generate LNAPL gradients that exceed transient groundwater capture gradients, then capture will fail to appreciably mitigate aquifer damages. That is why, again even with a perfect groundwater model, the Navy cannot at this stage determine what release mitigation measure might actually work under applied conditions. Half the question, and arguably the more complex half, remains

unaddressed (LNAPL migration at local scale). The other half (the GWFMs) are steady-state (not applicable to transient questions) and do not adequately reflect area data & conditions (they are faulty besides). So even though our meetings are ostensibly about the GWFMs, these broader issues are important to achieving groundwater protection measure in which we can have confidence and communicate that to our stakeholders.

Best regards, let me know if I have left any key questions unexplained in the above.